

REMARKS

Status of the Claims

Claims 1 and 4-7 are currently pending. Claim 1 is currently amended, and claims 2 and 3 are canceled. New claim 7 is added by this amendment. The Applicants affirm the election of Group I, claims 1-3 of the Restriction Requirement. Reconsideration and allowance of all of the claims is respectfully requested.

This amendment does not add new matter to the Application. Claim 1 is currently amended to incorporate the limitations of original claims 2 and 3, and claims 2 and 3 are canceled. New claim 7 is supported in the specification at, for example, page 7. The amendment to the specification merely deletes the recitation of certain redundant solvents. Accordingly, entry of this amendment is appropriate and respectfully requested.

Claim Objections

At page 4 of the Office Action, section 5, the Examiner objects to the molar ratio recited on page 4, line 5 of the specification. The Examiner asserts that the ratio is unclear in the absence of a denominator.

This ratio is described more fully at page 9, lines 11-16. There it is described that the ratio is of the liquid epoxy resin to the amine curing agent. Accordingly, withdrawal of this objection is respectfully requested.

At page 4 of the Office Action, the Examiner also objects to page 11, lines 22-24 of the specification and the recitation of the solvents contained therein.

The specification is currently amended to correct the redundancy. Withdrawal of this objection is respectfully requested.

Double Patenting

At pages 4-6 of the Office Action, claims 1-3 are provisionally rejected under the judicially created doctrine of obviousness double patenting, as unpatentable over claims 1 and 2 of copending Application 10/618,765 in view of JP 2002-12159, U.S. 5,371,279, JP 5-140267 and U.S. 5,840,417. For the following reasons, these rejections are each respectfully traversed.

The Applicants respectfully submit that the claims as currently amended are not obvious over the asserted references. Withdrawal of this rejection is respectfully requested.

Claim Rejections - 35 U.S.C. §103

At page 6-9 of the Office Action, claims 1 and 2 are rejected under 35 U.S.C. §103(a) as unpatentable over JP 2002-121259 in view of Qi (U.S. 5,371,279), JP 5-140267 and Bolger (U.S. 5,840,417); claims 1 and 2 are rejected under 35 U.S.C. §103(a) over JP 2002-121259; claim 3 is rejected under 35 U.S.C. §103(a) 35 U.S.C. §103(a) over JP 2002-121259 in view of JP 5-140267 and Bolger and further in view of JP 10-158366, JP 9-176924 and JP 60-92318; claims 1-3 are rejected under 35 U.S.C. §103(a) as unpatentable over JP 10-158366 in view of JP 2002-121259, JP 5-140267, and Bolger. For the following reasons, each of these rejections is respectfully traversed.

1. The present Invention

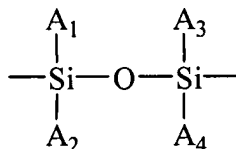
The present invention provides a liquid epoxy resin composition for semiconductor encapsulation which cures into a cured product that has improved adhesion to the surface of silicon chips and especially photosensitive polyimide resins and nitride films and improved toughness, does not suffer a failure even when the temperature of reflow elevates from the conventional temperature of nearly 240°C to 260-270°C, does not deteriorate under hot humid

conditions as encountered in PCT (120°C/2.1 atm), and does not peel or crack over several hundred cycles of thermal cycling between -65°C and 150°C.

The inventive liquid epoxy resin composition is effectively adherent to the surface of silicon chips and inter alia, photosensitive polyimide resins and nitride films, especially nitride films, does not deteriorate under hot humid conditions as encountered in PCT (120°C/2.1 atm), and is fully resistant to thermal shocks. The composition is thus suited as an encapsulant for large die size semiconductor devices.

2. Distinctions over the prior art

JP 2002-121259 discloses a liquid encapsulating resin composition comprising an epoxy resin having at least two functional epoxy groups, a silicone-modified liquid epoxy resin having disiloxane structure of the general formula (1), diaminodiphenyl sulfone, an inorganic filler, and a high boiling point solvent, wherein an equivalent amount of the curing agent per 100 parts by weight of the total of the epoxy resins and 5 to 20 parts by weight of the high boiling point solvent per 100 parts by weight of the total of the epoxy resins are present in the composition, and the modulus in tension of the cured product of the liquid encapsulating resin composition is up to 5 GPa:



wherein A_i is alkyl group or phenyl group.

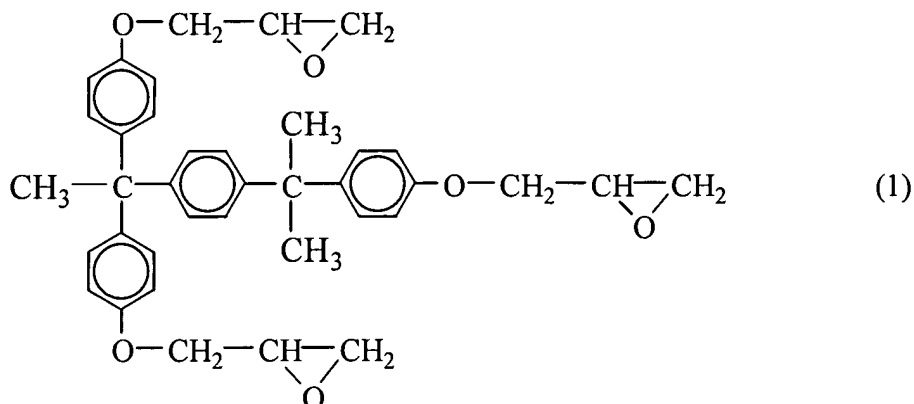
However, JP 2002-121259 fails to disclose or suggest the inventive molar ratio of the aromatic amine curing agent, i.e., the liquid epoxy resin (A) and the aromatic amine curing agent (B) are present in a molar ratio (A)/(B) from 0.7/1 to less than 0.9/1.

As is disclosed in the present specification, the total amount of the aromatic amine curing agent used herein should preferably be such that the molar ratio of the liquid epoxy resin to the aromatic amine curing agent, (A)/(B), is in the range from 0.7/1 to 0.9/1, more preferably from 0.7/1 to less than 0.9/1, even more preferably from 0.7/1 to 0.85/1. If the compounding molar ratio is less than 0.7, unreacted amine groups are left, probably resulting in a lower glass transition temperature and poor adhesion. With a molar ratio in excess of 0.9, there is a possibility that the toughness K_{Ic} value lowers and the cured product becomes hard and brittle enough for cracks to form during the reflow operation or thermal cycling.

JP 2002-121259 discloses in [0017] that it is preferred the blending amount of diaminodiphenyl sulfone be equivalent to the equivalent amount of the total of the epoxy resins. Therefore, JP 2002-121259 recommends the molar ratio of (A)/(B) of 1/1. Moreover, the toughness K_{Ic} of at least 3.5 according to the present invention is not expected from JP 2002-121259.

Qi '279 discloses a method of making a liquid ether acetate. However, Qi fails to disclose or suggest the presently claimed invention.

JP 5-140267 discloses an epoxy resin composition comprising an epoxy resin, a curing agent, and an organic solvent, the epoxy resin comprising a polyfunctional epoxy resin of formula (1):



and a glycidyl ether of novolak resin in a weight ratio of 0.5:9.5 to 9:1, the curing agent comprising o-cresol novolak resin having a softening point of 100 to 140°C, and the organic solvent comprising an organic solvent having a boiling point of 180 to 200°C and an organic solvent having a boiling point of 140 to 170°C in a weight ratio of 1:9 to 9:1.

However, JP 5-140267 fails to disclose or suggest the use of the inventive aromatic amine curing agent (B) and the molar ratio thereof to the epoxy resin. Moreover, the amount of the organic solvent of JP 5-140267 is 15 to 90% by weight. On the other hand, the amount of the organic solvent according to the present invention is 0.5 to 10 parts by weight per 100 parts by weight of the liquid epoxy resin (A) and the curing agent (B) combined. Therefore, the amount of the organic solvent of JP 5-140267 is larger than that of the present invention.

Bolger '417 discloses electrically conductive sheet material preforms useful in bonding of electronic components as well as in the formation of electronic circuits. The preforms, which comprise a multiplicity of electrically conductive adhesive members, each being separated from each other by means of a non-electrically conductive adhesive, are particularly useful in the assembly of multi-chip modules and multilayer electronic devices.

However, Bolger also fails to disclose or suggest the molar ratio of the aromatic amine curing agent according to the present invention, and the feature of the present invention.

JP 10-158366 and JP 9-176294 also fail to disclose or suggest the molar ratio of the aromatic amine curing agent according to the present invention. Further, they fail to disclose or suggest the inventive ester organic solvent of formula (1).

JP 60-92318 fails to disclose or suggest the use of the inventive ester organic solvent of formula (1). Moreover, JP 60-92318 does not teach that a large amount of an inorganic filler (i.e., 100 to 1,000 parts by weight of an inorganic filler per 100 parts by weight of the liquid epoxy resin) is blended.

Accordingly, the present claims are not disclosed or suggested by the prior art, and are presently allowable. An early reconsideration and Notice of Allowance are earnestly solicited.

Conclusion

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact J. Mark Konieczny, Registration No 47,715 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

Application No. 10/808,329
Amendment dated February 22, 2006
Reply to Office Action of September 22, 2005

Docket No.: 0171-1077PUS1

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to our Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under § 1.17; particularly, extension of time fees.

Dated: February 22, 2006

Respectfully submitted,

By 

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